

ProGres – valuable products from residual
biomasses towards a greener society

IProPBio: Intergrated Process and Product design for sustainable Biorefineries

Final workshop 26 June 2023



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Workshop program 26 June 2023,
Det adelige jomfrukloster, Odense

9:00 Welcome and introduction,
Massimiliano Errico

9:30-10:15 Alejandro Franco: How upcycling coffee can match market needs: Kaffe Bueno's story on realizing the world's coffee bio-refinery

Kaffe Bueno is an award-winning Danish bioscience company upcycling coffee by-products into active and functional ingredients for personal care, nutraceuticals, food & beverage, and other industries.

Its vision is to change how the world perceives coffee, from a caffeinated beverage to a sustainable resource, by unlocking its health potential.

Kaffe Bueno was founded in Denmark in 2016 by three Colombian entrepreneurs; Alejandro, Juan, and Camilo. As business graduates, they realised the magnitude of the food waste – and particularly coffee – and saw opportunities in using different scientific disciplines to use coffee as a platform to satisfy consumer and industry pains across different industries.

During the keynote, Alejandro will share their journey from idea to building the world's 1st coffee biorefinery, and commercialising compounds to companies like Beiersdorf (Nivea) and The Body Shop.

About Alejandro Franco: *Alejandro is the Co-Founder and Chief Commercial Officer at Kaffe Bueno. With his background in business and biochemistry, he is the bridge between the market and R&D, ensuring the company's innovations address specific market needs and consumer pains. He oversees business development, overall commercial strategy and operations, strategic partnership development, and circular projects.*





10:15: 11:00 Seyed Soheil Mansouri: A unified multi-scale strategy for bio-manufacturing process development

Process engineering requires information at various levels of granularity from the microscale to the macroscale including reaction mechanism (catalytic) and/or cell metabolic pathways (biocatalytic), reaction kinetics, reactor design specifications, transport phenomena, and interaction of the microscale to the macroscale and vice-versa. While many of these phenomena can be modeled mechanistically, engineering towards a goal of maximizing final process throughput, and other constraint satisfaction, requires tools from artificial intelligence such as search, optimization and sampling, and machine learning to model process correlations. The complexity is further enhanced due to the unavailability of data from many critical microscale variables such as metabolic fluxes, cell morphology, cell viability, etc. This is not disregarding the stochasticity in the dynamics of the individual cells and observability limitations of the process.

Here, a strategy to bridge across scales (from micro- to macro) for bringing a product from lab to pilot-scale and eventually full implementation will be presented. More specifically, first an overview of the status within process systems engineering will be given. Next, an overview of a systematic methodology for bioprocess scale-up taking advantage of a combination of mechanistic-data-driven modeling strategies and validation and qualification with non-invasive measurement technologies such as capacitance, NIR and image processing will be highlighted. Two specific case studies are tackled in this presentation.

About Seyed Soheil: *Dr. Seyed Soheil Mansouri is an Associate Professor in the Department of Chemical and Biochemical Engineering at the Technical University of Denmark (DTU) and affiliate faculty at Sino-Danish Center for Education and Research in Beijing, China. His current research is focused on Process Systems Engineering, System Dynamics, Computational Agility (AI and Quantum Computing), Socio-Economic-Technological Analysis of Complex Dynamic Systems, Process Synthesis, Design, Control and Intensification with focus on Chemical, Pharmaceutical and Bio-manufacturing sectors. He is a senior member of American Institute of Chemical Engineers (AIChE) and Danish representative to Computer Aided Process Engineering (CAPE) Working Party of European Federation of Chemical Engineers (EFCE). Recently, he has engaged in the Biosolutions Zealand project to design, develop and tackle the economics of scale associated with production systems for biomolecule scale-up combining PSE and pilot-scale validation.*

11:00 – 11:15 Break



11:15 – 12:00 Morten Ambye-Jensen: Development of Green Biorefineries to decrease environmental impact of agriculture and maximize production of local protein- and biomass supply for the green transition

Compared with annual grain and seed crops, perennial grassland has significantly lower losses of nutrients and low pesticide requirements, whilst also supporting soil carbon build-up. Forage crops can deliver high yields of biomass as well as protein with a well-balanced amino acid profile. A green biorefinery concept has been developed to cover up to 40% of the forage protein into a protein concentrate for feed with around 50% protein, a fiber fraction for ruminant feed, bioenergy, or further biorefined into chemical building blocks or bio-materials as well as a liquid residue full of soluble carbohydrates and inorganic nutrients. Feed experiments with the concentrates have shown that biorefined grassland protein can provide a substitute for soybean meal for poultry and pigs without negative effects on animal performance. The first industrial-scale biorefineries on green biomass for feed and bioenergy are now established in Denmark, although more research is needed in order to evaluate protein quality for both feed and food applications and further valorize the side streams. The green biorefinery concept opens new markets for grassland and opportunities for increasing the grassland area to obtain associated ecosystem services.



About Morten Ambye-Jensen: he is an Associate Professor and researcher within biorefining technologies with a solid background and experience in process engineering and biotechnology, bringing green developments from lab- to demonstration scale. Group leader of Green Biorefining Technologies, at Aarhus University, Department of Biological and Chemical Engineering, including 3 postdocs, 2 PhD and 5 technicians/process engineers. Manager of the AU Demonstration Platform for research and development in green biorefining, and Head of the cross-disciplinary AU Centre for Circular Bioeconomy CBIO.



12:00 – 13:30 Lunch and poster session

13:30- 14:30 Massimiliano Errico: Integrated Process and Product design for Sustainable Biorefineries: the achievements of the IProPBio project and its future

The overall goal of IProPBio is to exchange complementary theoretical and experimental knowledge of research Staff while looking for innovative answers to such important questions. Alternative feedstock and high-value products characterization; thermodynamic data analysis and properties prediction; alternative technological flowsheets for economic and eco-compatible conversion of waste biomass into high-value products; mass and energy integration studies to reduce wastes and enhance the profitability; life cycle assessment to determine the net contribution of the best designs to environmental pollution are the main issues approached in the project. The main achievements will be presented together with the next step to fully achieve the goal of the Green Transition.

About Massimiliano Errico: *he is an Associate Professor at the Department of Green Technology of the University of Southern Denmark. He is the coordinator of the IProPBio and the Zero Emission Ports North Sea projects. He participated as principal investigator in different EU and nationally financed projects focused on valorizing different biomasses. His main research area is process system engineering in particular the synthesis of multicomponent separation alternatives and optimization methods related to the separation of biofuels and platform compounds. Since 2017 he is the head of the Master Programme in Chemical Engineering and Biotechnology at SDU and in 2021 he won the TEK-Teaching prize as best teacher of the Faculty of Engineering.*

Poster Session

1. **Optimal integrated plant for renewable surfactants production** by Sofia González-Núñez, Mariano Martín, Carlos Amador
2. **Modelling the Kinetics of SCE of Valuable Compounds from Biomass Waste – Hurdles and Challenges** by Filipe R.F., Coelho J.P., Robalo, M.P., Cholakov St.G., Stateva R.P
3. **Industrial Biomass Wastes as Sustainable Future Sources of Value-Added Products** by Coelho J.P., Robalo M.P., Filipe R.F., Boyadjieva S., Yankov D.S., Stateva R.P.
4. **EnvChemPSE group from Instituto Tecnológico de Aguascalientes: our contributions to the production of bioproducts and biofuels** by Mendoza-Castillo D.I., Reynel-Avila H.E., Bonilla-Petriciolet A.
5. **Extraction processes and valorization of residual biomass of *Cercis siliquastrum* and prickly pear** by Laura Gabriela Elvir- Padilla, Alexandra Spyrou, Samir Santzouk, Ileana Mentoza-Castillo, Adrian Bonilla-Petriciolet, Maria Antonopoulou, Maria Papadaki
6. **Direct ethanolysis of Avocado seeds for the synthesis of Ethyl Levulinate** by Luigi di Bitonto, Luis Ricardo Shigueyuki Kanda, Marcos Lucio Corazza, Carlo Pastore
7. **A network of processes for biorefining burdock seeds and roots** by Enrico Scelsi, Luigi di Bitonto, Luis Ricardo Shigueyuki Kanda, Marcos Lucio Corazza, Stefan Stefanov, Roumiana P. Stateva, Ileana Mendoza Castillo, Adrián Bonilla-Petriciolet, Mahmoud El-Halwagi, Massimiliano Errico, Carlo Pastore
8. **Sustainability analysis of biomass residues processing for added-value products. Peel orange as a case study** by António Clemente, Henrique A. Matos, Mariano Martín, Catarina G. Braz
9. **Integrated processes for market-value compounds and energy production** by Marcos L. Corazza, Massimiliano Errico, Vanessa Carvalho, Nadia Ramos, Giuliana Varela



Research, Fairy Tales, Life & Authorship

The Hans Christian Andersen Centre works with literary, cultural and communication approaches to H.C. Andersen's work, life and cultural significance. The center is also based in Odense Secular Convent for Noble Women.

Odense Adelige Jomfrukloster

Built in 1504, *Odense Secular Convent for Noblewomen*, situated in the historic city centre, is one of Denmark's oldest preservation-worthy buildings. In its role as a bishop's palace and later as property of the crown, and from 1716 onwards as a home for unmarried noble ladies, the building documents centuries of changing times, functions and demands, layer upon layer, inside and out. Realdania By & Byg acquired the property in 2008, and over the next five years carried out one of the most comprehensive restoration projects of recent times. Today, researchers from the University of Southern Denmark are helping to plan a new future for the convent.

Reference: realdania.dk, photos: Kurt Rodahl Hoppe



Welcome to Odense - hometown of Hans Christian Andersen

Odense is rapidly evolving, and if you haven't visited in the last few years, you'll be surprised by all the new possibilities. A new H.C. Andersen House, a brand new quarter in the city centre covering the real estate that the enormous 4-lane thoroughfare used to cover, the light rail is running, exciting things are happening at the harbour and much more.

At the same time, Odense also features cobble streets and colourful little row houses in the historic quarter, fantastic and sometimes quirky festivals throughout the year and a location in the middle of the island Funen, known for its many castles and manor houses and beautiful scenery.

We love Odense, of course, and luckily we're not the only ones.

International media that recommend Odense like – *Vogue*, with an article listing the finest harbour baths in Denmark (including ours in Odense, of course), and *100 most loved places* - Odense is on the list and *New York Times'* list of 52 of places to visit in 2023.

Reference: [visitodense.com](https://www.visitodense.com)



SDU Campuses

The University of Southern Denmark (SDU) has more than 26,700 students and 3,900 employees. The campuses of the university are represented in 6 cities: Odense, Esbjerg, Kolding, Copenhagen, Slagelse, and Sønderborg - all with main focus on education and research.

This photo is from Campus Odense, where the new Odense University Hospital are being connected, providing a breeding ground for strengthened cooperation between the two organisations. University and hospital under one roof.

See more at sdu.dk

Research at the University of Southern Denmark

The University of Southern Denmark works purposefully to create dialogue between the university's researchers and the surrounding society. The answers to societal challenges are often found in the interaction between highly specialized academic environments. When these environments collaborate, perspectives are expanded, and new insights emerge.

Department of Green Technology

Through its research, innovation and study programmes the department will contribute with solutions to global social and environmental problems. We will help create growth and prosperity through technically sound engineering solutions that integrate other disciplines. The department will be a gateway for lifelong learning for employees, students, and project and network partners.

By means of various forms of cooperation such as internships, student projects, networking and research projects with the industry and other public research institutions, there is a constant exchange of experience and knowledge which ensures that all parties have access to the latest and most relevant knowledge.

Contact

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Workshop location

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